Next-Generation Mobile Networks and their Implications for Video Applications

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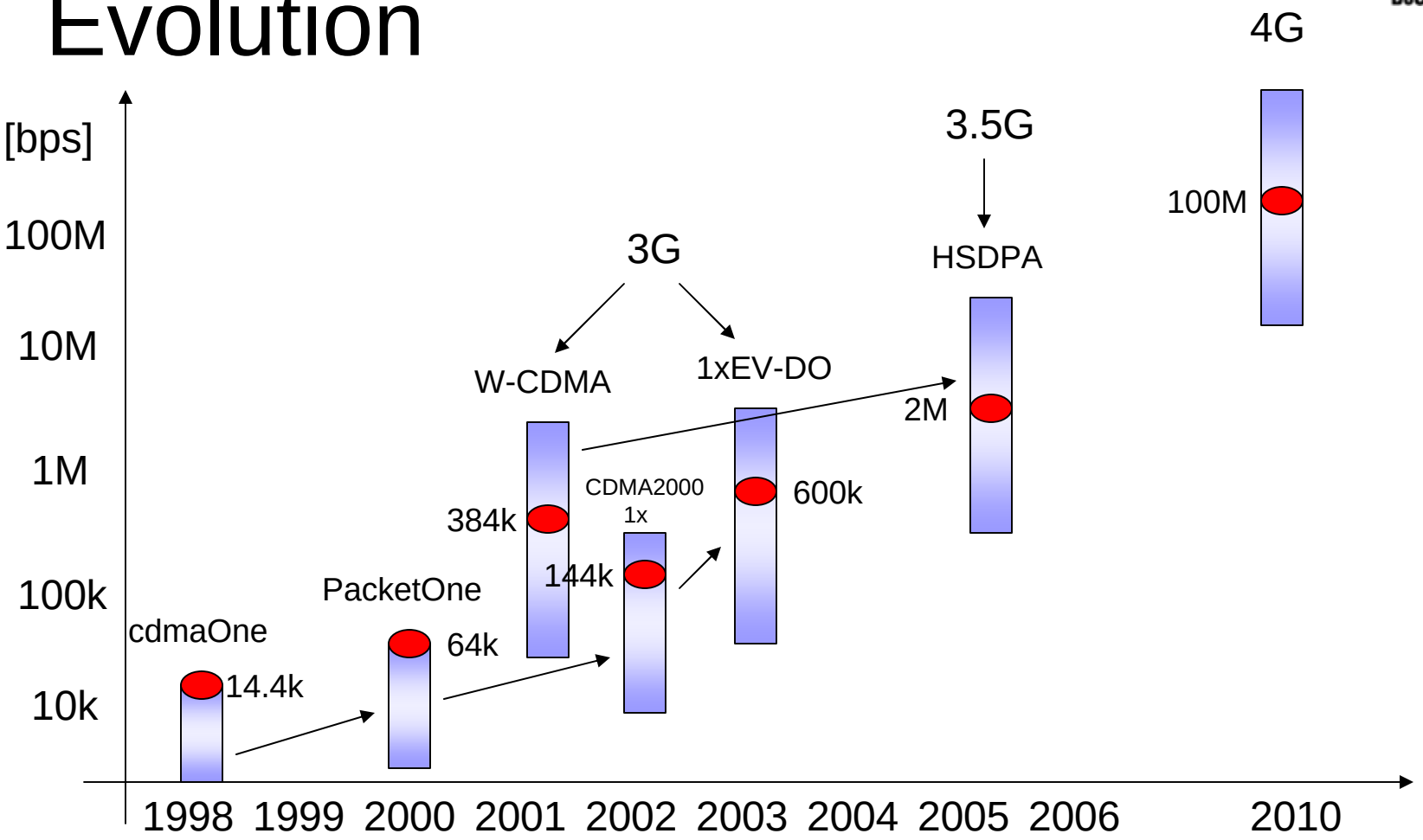
Workshop on Future Directions in Video Coding
Busan, Korea
April 20, 2005

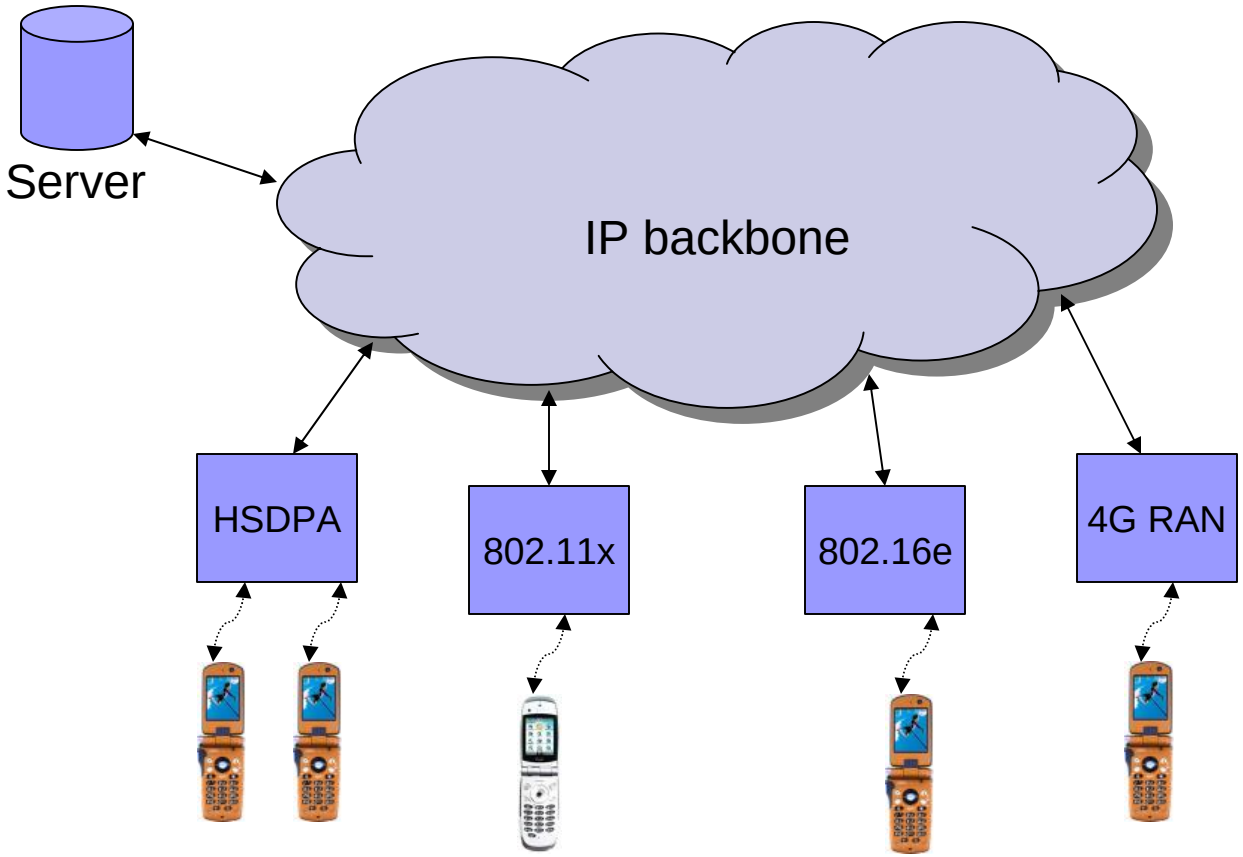
The Long Road to Multimedia in 3G

- 2001:
  - Deployment of W-CDMA networks with up to 384kbps bandwidth
  - MPEG-4 video and AAC available
- 2004:
  - Multimedia traffic takes off
  - Introduction of flat-rate pricing
- Business models matter just as much (more?)

Radio Access Technology Evolution



4G Network Architecture (simplified)



Mechanisms for Physical and Link Layers QoS (1)

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- Adaptive Modulation and Coding (AMC)
  - Transmission power is kept constant
  - Packet loss rate is kept constant (very low)
  - Modulation is adapted to channel condition:
    - QPSK, 8-PSK, 16-QAM, 64-QAM (HSDPA)
  - Coding is adapted to channel condition:
    - Multiple code rates for FEC (Turbo coding)
- Hybrid Automatic Resend Request (H-ARQ)
  - Option to resend packet if no acknowledgment received within given time
  - Further reduces packet loss rate

Mechanisms for Physical and Link Layers QoS (2)

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- Multiple QoS classes:
  - Conversational, Streaming, Background
  - Transmission parameters adapted to class
  - Queuing priority adjusted to class

- Bottom line:
  - “Good” state with very low packet loss rate
  - “Bad” state with very high packet loss rate
  - Variable channel capacity
- Requirement for video:
  - Ability to quickly recover from “bad” state

Application Spaces

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Application	Transport	Expected PLR	Requirements
Conferencing	RTP/UDP/IP	0.1%	Occasional packet loss Fast recovery
Streaming	RTP/UDP/IP	0.01%	Occasional packet loss Fast recovery
Progressive Download	TCP/IP	<0.01%	
Broadcasting	RTP/UDP/IP	0.1%	Occasional packet loss Fast recovery
Messaging	TCP/IP	<0.01%	

Summary

- Mobile networks are evolving
  - All-IP, multiple radio access technologies
  - Significant increases in bandwidth
  - Significant reductions in packet loss rate
  - Two-state behaviour: “good” and “bad”
- Requirements for video
  - Coding efficiency
  - Low complexity
  - Resilience to occasional packet loss
  - Ability to quickly recover from catastrophic failures
- Remaining issues
  - Rate control for TCP streams
  - Latency reduction

The Video to come

- Small size to remain because of form-factor constraints
  - QCIF/CIF/QVGA
  - Several 100kbps
  - Frame rate to remain constrained by power consumption
- In more distant future:
  - Stereoscopic video using autostereoscopic displays
  - Higher resolutions with flexible displays
- Business model remains a big issue